INSTRUCTION MANUAL

HL610
HL610 LIMITED
HL620

INTEGRATED THERMOMETER

Anritherm

ANRITSU METER CO.,LTD.

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HL620

INTEGRATED THERMOMETER

Anritherm

No. 8603-1

ANRITSU METER CO.,LTD.

WARRANTY

The ANRITSU METER CO., LTD. warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of one year from date of purchase. This warranty extends only to the original purchaser and does not apply to any instrument which has been subject to misuse, accident, or abnormal operating conditions. Disposable batteries are not covered under this warranty.

All requests for repairs and replacement parts should be directed to the ANRITSU METER CO., LTD. or the nearest ANRITSU representative in your area.
Please indicate the model and serial number giving full details of the problem encountered.

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P R E F A C E

This manual provides complete operating and maintenance instructions for the HL610, HL610 LIMITED and HL620.digital thermometers.

Reader's Guide

This manual is organized into 9 sections.

SECTION 1, INTRODUCTION AND SPECIFICATIONS, provides a brief description and specifications.

SECTION 2, OPERATING INSTRUCTIONS, provides complete operating instructions.

SECTION 3, MEASUREMENT TUTORIAL, provides considerations and techniques to help you use effectively.

SECTION 4, THEORY OF OPERATION, provides an overall functional description.

SECTION 5, MAINTENANCE, provides manitenance information.

SECTION 6, LIST OF REPLACEABLE PARTS, provides an illustrated replaceable parts list.

SECTION 7, INTERCHANGEABLE THERMOCOUPLE PROBES, provides brief introduction of ANRITSU standard probes which are selected from 300 kinds of standard probe series.

SECTION 8, INDEX

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The option include;

- An ac power adaptor

Specifications

1. Temperature Range

- HL610K, HL610K LIMITED, HL620K (Thermocouple type K)
  -200 to 1200°C (-100.0 to 500.0°C /0.1°C)
  -328 to 2192°F (-148.0 to 932.0°F /0.1°F)

- HL610E, HL610E LIMITED, HL620E (Thermocouple type E)
  -200 to 800°C (-100.0 to 500.0°C /0.1°C)
  -328 to 1472°F (-148.0 to 932.0°F /0.1°F)

- HL610J, HL610J LIMITED, HL620J (Thermocouple type J)
  -200 to 700°C (-100.0 to 500.0°C /0.1°C)
  -328 to 1292°F (-148.0 to 932.0°F /0.1°F)

2. Input channel

- HL610, HL610 LIMITED 1 channel
- HL620 2 channels

3. Accuracy

- HL610, HL620 ± [0.1% of reading + 0.3°C(0.6°F)]
- HL610 LIMITED ± [0.05% of reading + 0.1°C(0.2°F)]

4. Temperature Coefficient

- HL610, HL620
  Included in accuracy spec. (20 to 30°C operation)
  ± 0.01% of reading /°C (Other ambient operating temp.)

- HL610 LIMITED
  Included in accuracy spec. (20 to 30°C operation)
  ± 0.005% of reading /°C (Other ambient operating temp.)

5. Maximum Input Voltage

20V dc or 10V rms ac on thermocouple probe input

6. Reading Rate

   Approx. 200 msec. / reading

7. DIsplay

   Multi-data LCD display with illuminator

8. Functions

   Hold, P·V Hold, AVE, 1/0.1, °C/°F, CAL, ALM, DIFF(HL620 only)

9. Output

   Alarm ON/OFF output (TTL level)

   Centronics 8-bit parallel

   Calibration interface

10. Power Supply

    4 "AA"(R6) Dry batteries

11. Battery Life

    120 hours (continuous) Alkaline batteries

    40 hours (with continuously illuminated display)

12. Environmental Limits

    Operation : -10 to 45°C , 0 to 80%R.H.

    Storage : -20 to 60°C , 0 to 85%R.H.

13. Dimensions

    74 X 142 X 31 mm

14. Weight

    Approx. 240g (Including batteries)

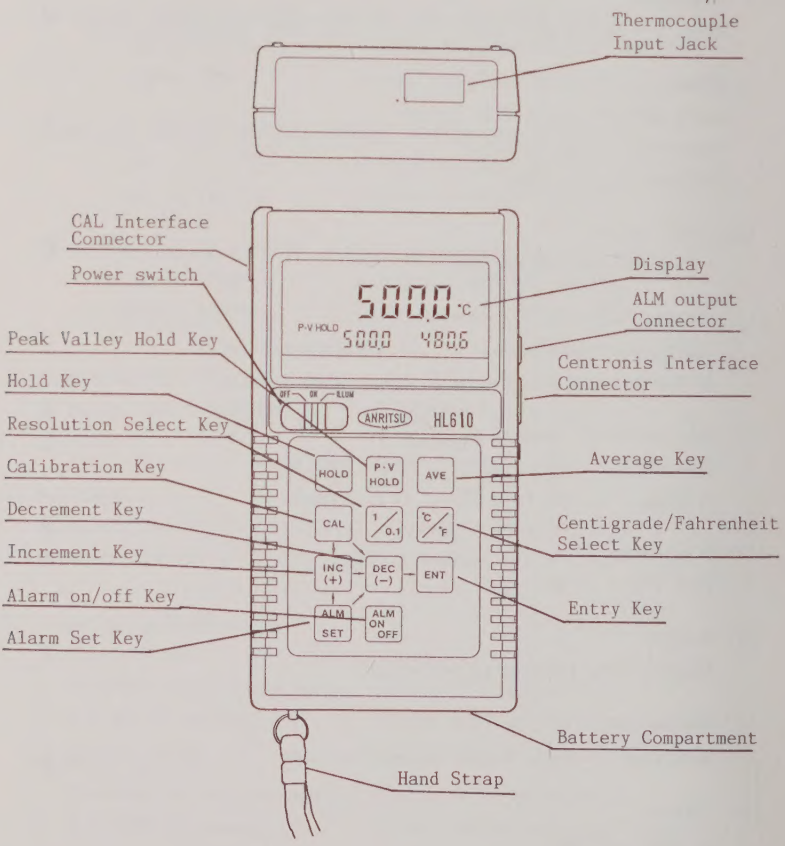
15. Accessories

    Batteries (4 pcs), Rugged protective case

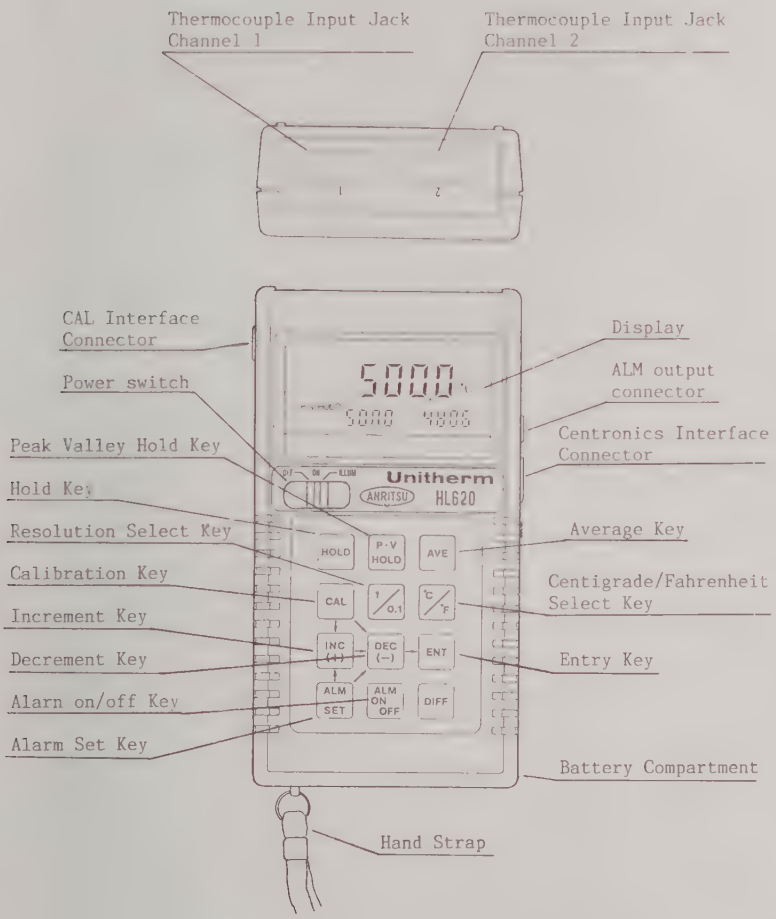
16. Option

    AC power adaptor

Names of Compornent : HL610, HL610 LIMITED



Names of Comportnent : HL620



** NOTES **

OPERATING INSTRUCTIONS

Introduction

This section describes how to make measurements with your HL600. Please take time to read this manual carefully so that you can take full advantage of the wide variety of measurement functions offered by the HL series.

Unpacking and Repacking

Your instrument was shipped with;

- 4 pcs of 1.5V battery
- A rugged protective case
- This manual

Contact the place of purchase if anything is missing or damaged in shipment.

Please use the original container if reshipment is necessary.
If the original container is not available, the instrument should be carefully wrapped with shock-absorbing material.

Battery Installation

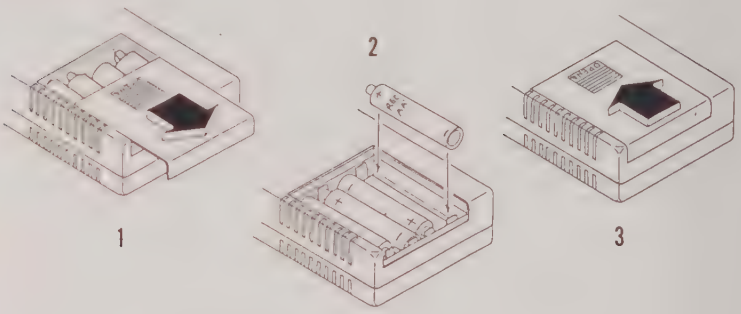
The HL600 is designed to operate on four 1.5V batteries.

When you receive the instrument, the batteries will not be installed. Once the batteries are installed, you can expect a typical operating life of up to 100 hours with carbon-zinc batteries or 120 hours with alkaline batteries.

[NOTE]
The set cannot be operated on the internal batteries when either the ac power adaptor or battery pack is connected to the set.

[NOTE]
In very cold conditions (ambient temperature below 5°C), alkaline batteries are recommended.

Use the following procedure to install or replace the four 1.5V batteries:



1 Remove the battery compartment cover.
2 Set four 1.5V batteries ("AA"(R6))
3 Close the battery compartment cover.

[CAUTION]
When the set is not to be used for a long period of time or is to be operated extensively on other power sources, remove the batteries to avoid damage to the set caused by battery leakage and corrosion.

Battery Level Indication

When the battery has exhausted about 80% of its useful life the indicator will appear at the far left of the display. Your instrument will continue to operate properly for at least 24 hours with alkaline batteries after first appears on the display.

In this case, replace the batteries.

If the batteries are completely exhausted, no indicator will be displayed.

■ Lithum Battery

A lithum battery is connected and fixed on printed circuit board to back up RAM.

The life time of the lithum battery is approx. 3 years.

> When the lithum battery exhausted about 90% of its useful life the 🔋 indicator will turn on and off. In this case, contact the place of purchase or refer to MAINTENACE.

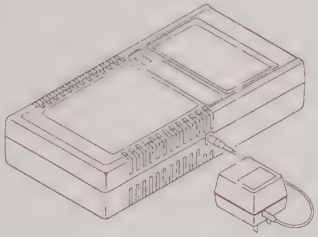
A random assortment of data may be displayed on calibration mode and alarm settings if the lithum battery has exhausted.

Other Power Sources

■ HOUSE CURRENT

Use the ac power adaptor.

First connect the adaptor to the dc 6V jack, then plug the adaptor into outlet.

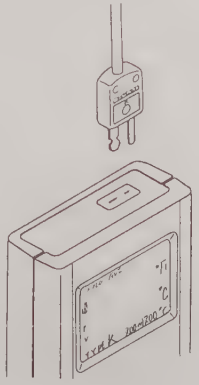


■ BATTERY PACK

First connect the battery pack to the instrument dc 6V jack, and then turn on the power switch.

Probe Installation

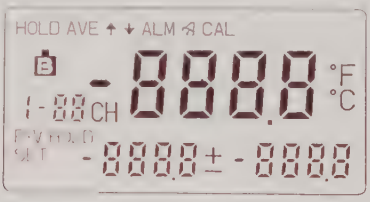
Insert a suitable type of thermocouple probe to the input jack. The thermocouple type is indicated below the display.



The HL620 has 2 input jacks. If you measure differencial temperature, connect probes to both of jacks.

Power On

Turn the power switch ON. The instrument automatically performs a self-test to make sure the display and microprocessor are functioning properly. If normal, all the LCD segments in the display will turn on and one or two seconds later, the instrument will cause a short beep before the measurement start.



If the LCD segments do not all turn on during the self-test, or if the instrument does not respond to key operations after the self-test, something is probably wrong with the instrument. Try the test again, check the batteries, and if it fails, contact the place of purchase.

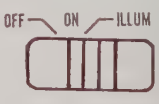
[CAUTION]

If you turn off your instrument and then immediately turn it back on, a random assortment of LCD segments may be displayed. In this case, turn the instrument off and waiting at least three seconds before switching it on again.

■ Power Switch

Power Off

Power On



Power and illuminator On

[NOTE]

Three kinds of temperature are displayed at the same time on the multi-data display.

For more information, refer to Peak Valley Hold.

Illuminator On

Turn the power switch ILLUM, the LED plate behind the LCD display will illuminate. When on, the illumination uses three times the battery power as opposed to normal operation without illumination.

Overrange Indicator

If the "or" symbol appears on the display during the measurement, this means that the measuring temperature is out of the range.

If the temperature is higher than the highest level of the range, "or" and "↑" will be displayed.

If lower than the lowest level of range "-or" and "↓" will be displayed.

[NOTE]

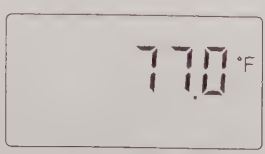
These symbols do not necessarily mean that the instrument is being exposed to a damaging input condition.

Burnout Indicator

If "bo" and "↑" symbol appears on the display, the connected probe is probably broken or a probe is not connected to the input jack.

°C/°F Centigrade/Fahrenheit

Centigrade (°C) or fahrenheit (°F) can be selected by pressing °C/°F key.



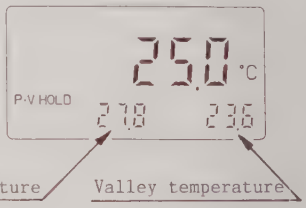
HOLD Hold

The reading of measuring temperature can be held by pressing [HOLD] key.
This mode can be released by pressing the [HOLD] key again.

[NOTE]

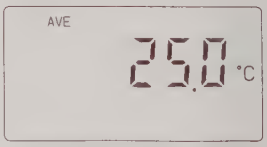
P·V HOLD Peak Valley Hold

Peak (maximum) and Valley (minimum) temperatures can be displayed below the main reading by pressing [P·V HOLD] key.
This mode can be released by pressing the [P·V HOLD] key again.



AVE Average

Averaged temperature of every 10 scans can be displayed by pressing [AVE] key.
This mode can be released by pressing the [AVE] key again.



[NOTE]
Peak and valley readings are averaged in the P V Hold mode.

1/0.1 Resolution

Resolution (1 degree or 0.1 degree) can be changed 0.1 to 1 or 1 to 0.1 by pressing [1/0.1] key.

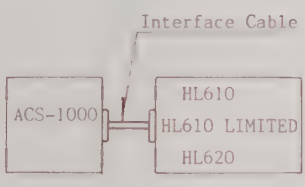
CAL | CAL

■ Auto-calibration

ANRITSU surface temperature calibrator model ACSI-1000 is available to calibrate the instrument and probe together.

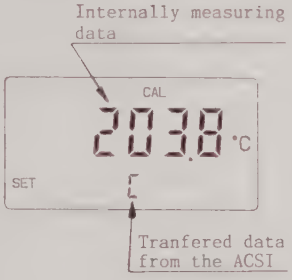
Turn off the power of the HL.

Connect an interface cable to the ACSI-1000.
The calibrator should be warmed up enough and it's reading should be stable before start the calibration.



Turn on the power switch of the HL.
Put the probe on the calibrator.

"CAL" and "SET" are displayed by pressing [CAL] key.



Press a TRANS key of the calibrator, then the calibrating temperature is transfered to the HL and displayed instead of "C" on the sub-data display.

If the transfered temperature is correct press [ENT] key.

■ Manual-calibration

"CAL" and "SET" are displayed by pressing the [CAL] key.

A reading on the sub-display can be changed by pressing [INC (+)] or [DEC (−)] key.

Press the [ENT] key if the setting data is correct.

[NOTE]

If you added a certain value in this mode, the same value is always added in whole temperature range of this instrument.

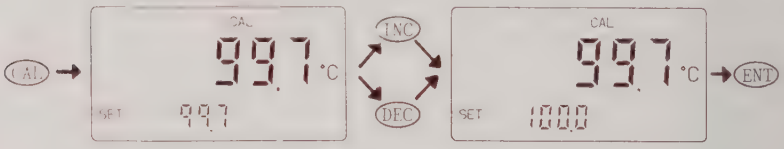
The CAL indicator is displayed when the reading temperature is calibrated.

■ Cancellation

The CAL mode can be canceled by pressing the [CAL] key and then the [ENT] key.

[EXAMPLE] ** Manual Calibration without the calibrator. **

Caribration temperature : 100.0 °C



ALM SET ALM SET

An alarm level can be programmed in this mode.

■ Alarm setting level

Most of temperature monitors require the programming procedure as shown in below. This instrument has the same procedure.

Center of monitoring temperature	±	Width of monitoring temperature

[EXAMPLE]

300 °C ± 10°C

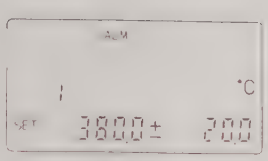
290 300 310 Temp.

Beep	ON	OFF	ON
Output P2	LOW	LOW	HIGH
Output P3	HIGH	LOW	LOW

The alarm setting mode can be selected by pressing [ALM SET] key.

1) Central temperature setting

Set a central temperature by pressing the [INC (+)] or [DEC (-)] key.



Press the [ENT] key if the data is correct.

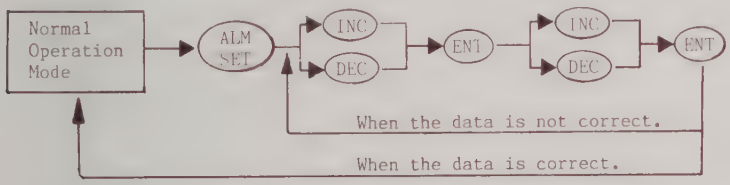
2) Monitoring range setting

Set a monitoring range by pressing the [INC (+)] or [DEC (-)] key.

Press the [ENT] key if the data is correct.

If the either of setting data is not correct, you will hear a short beep and the instrument will back to the central temperature setting mode.

The 1/0.1 and °C/°F functions are available during the ALM SET mode.



The ALM SET mode can be terminated by pressing the [ALM SET] key again during the alarm level setting.

[NOTE]

The programmed alarm data in the RAM is backuped during the power off.

ALM ON OFF

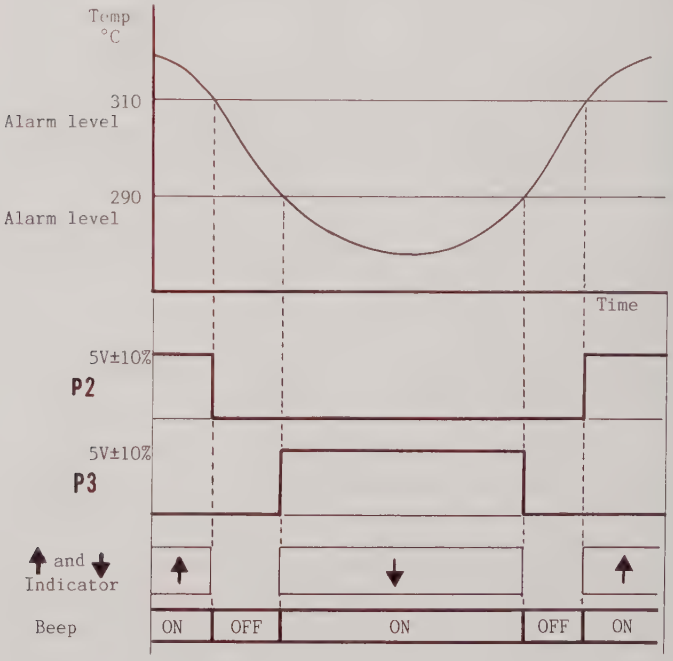
The instrument beep when temperature is out of setting range if the ALM is ON. Alarm signals ayways out from the alarm connector.

The alarm beep can be turned on by pressing

key.
This alarm beep can be turned off by pressing the

key again.

■ Details of alarm function



DIFF (only HL620)

Differencial temperature between 1ch to 2ch is displayed in DIFF mode.

Temperature of 2ch can be displayed by pressing DIFF key.

And the differencial temperature can be displayed by pressing the DIFF key again.

Temperature of 1ch can be displayed by pressing the DIFF key again.

[CAUTION]

If you push the DIFF key during the Hold, P V Hold and Ave mode, these modes are released and the each reading data in the RAM is cleared.

Differencial temperature = 1 ch temperature - 2 ch temperature

Alarm Out

■ Interface Connector

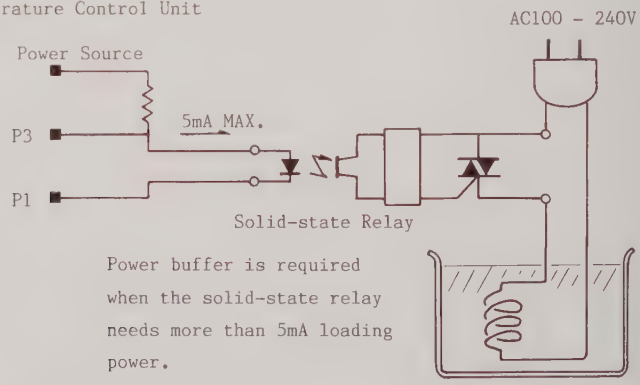
No. of Terminals	Name of Signals
1	DATA STROBE
2	DATA 1
3	DATA 2
4	DATA 3
5	DATA 4
6	DATA 5
7	DATA 6
8	DATA 7
9	DATA 8
10	N.C.
11	BUSY
12	GND (OV)
13	ALARM H
14	ALARM L
15	CHECK

[CAUTION]

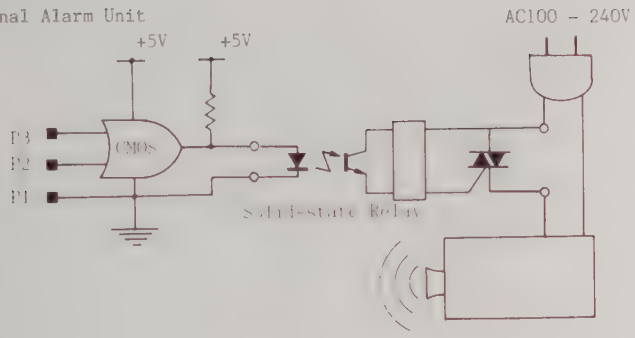
No. 4 pin can not be used for external device power source.

[Application example]

■ Temperature Control Unit



■ External Alarm Unit



Centronics Parallel Interface

■ Name and Function of Signals

a) $\overline{\text{DATA STROBE}}$ (OUT)

The signal indicates effectiveness of data (DATA 1 to DATA 8) and the width of pulse is MIN. 1 μ sec. Under the steady state, it indicates "High", and when the datas are effective, it indicates "Low".

b) DATA 1 to DATA 8 (OUT)

This signal indicates information of datas from the first bit to the eight bit.

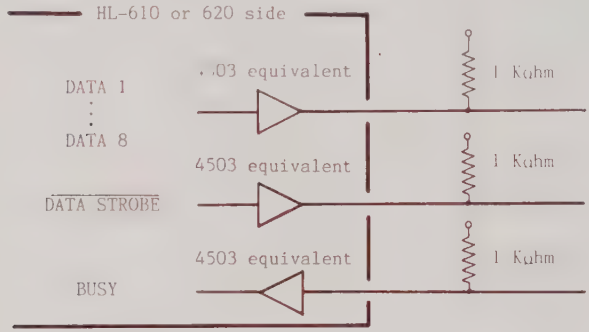
Data 1 ..... "High" Data 0 ..... "Low"

c) BUSY (IN)

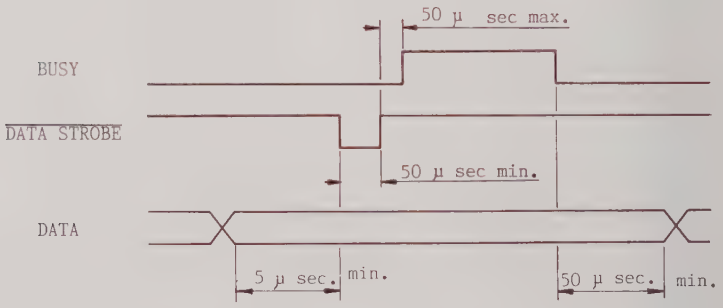
This signal is of dc level, and indicates whether communication of HL-610 or 620 is possible or not. ("Low" : possibel)

The datas (DATA 1 to DATA 8) are effective until "High" changed to "Low".

■ Interface Circuit



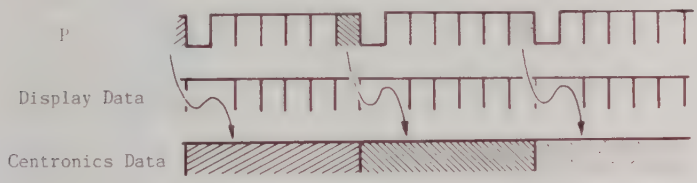
■ Timing Chart (Interface)



■ Timing Chart (Internal Data Storage for Centronics)

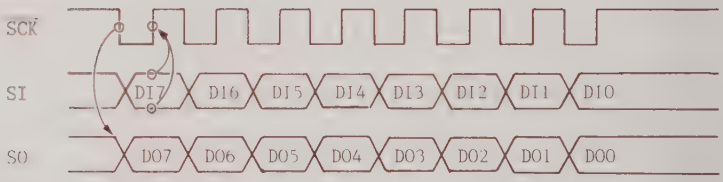
[NOTE]

Refer to Scan Timing in THEORY OF OPERATION SECTION 4.



CAL interface

Pin No.	Name	Signal
1	P1	GND
2	P2	SCK
3	P3	SI
4	P4	SO
5	P5	N.C.
6	P6	N.C.



DI : Input serial data

DO : Output serial data

MEASUREMENT TUTORIAL

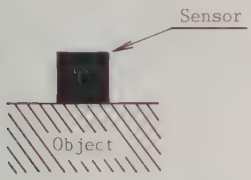
Introduction

This section provides considerations and techniques to help you make precise temperature measurements.
The most accurate temperature measurements start with the selection of the proper probe. We have many kinds of instruments to support various applications in addition to a variety of more than 300 Standard Plug-in Interchangeable Sensors.

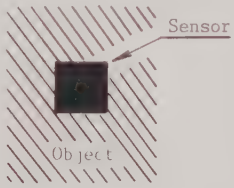
There are the vast number of possible objects to measure can be divided into the four types; surface, liquid, gas and solid.

Surface Temperature

Surface temperature measurement is very difficult and different from the liquid and gas(air) measurements. In case of the gas and liquid measurements the sensors are surrounded by the objects.

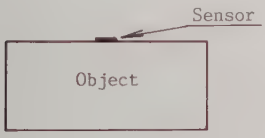


Surface

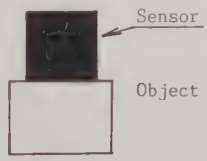


Liquid and Gas(Air)

■ The mass of the sensor should be small in relation to the mass of the part being measured.



Good



Poor

■ The mass of the sensor should be small in relation to the material (Thermal resistance) of the part being measured.

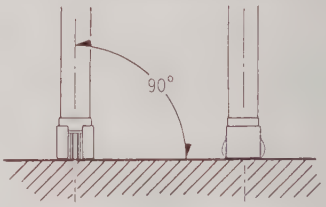
For example, the thermo resistance of iron is smaller than plastic, glass, and rubber.
Smaller sensor provides a better measurement when the material has a large thermo resistance such as plastic.

■ The contacting area of the sensor is big in relation to the mass of the sensor.

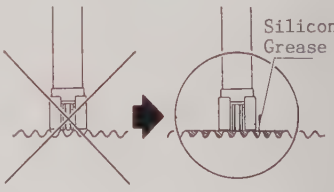
1	Mass	1	1
Greater than 100	Contacting Area	1	Less than 0.001

■ How to use

ANRITSU surface probes are designed to be pressed perpendicular to the surface.



If the surface is not smooth and flat, good thermal contact can not be expected. In this case apply silicon grease to the material surface.



If the surface is moving, use ANRITSU probes designed for moving and rotating surfaces probes.
For more details, see our catalog.

Liquid Temperature

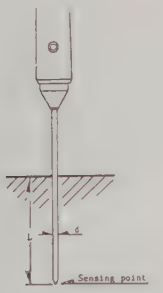
Obtaining liquid temperature measurements are much easier than surface temperature measurements. But there are still important things

that should be kept in mind.

- The mass of the sensor should be small in relation to the mass of the liquid being measured.

- The inserted depth of seath type probe should be longer than 17 X Diameter of seath.

$$L = 17 \times d$$

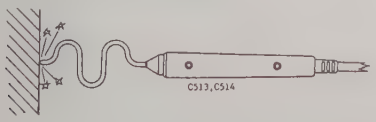


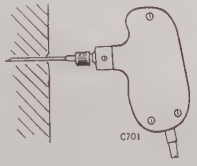
Gas (Air) Temperature

The thermo resistance of the gas is very big. Air is good for heat-insulator. If the gas is very static, response time of the probe will be delayed. If you want to obtain a quick reading, shake the probe head.

Solid Temperature

If the object is a semi-solid material, you can use the same probe as you would use for liquid measurements. But if it is hard material, sensor top should be very hard structure.





** NOTES **

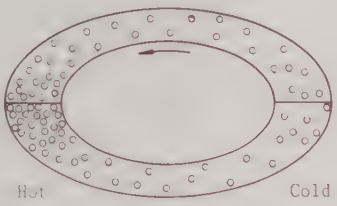
THEORY OF OPERATION

Introduction

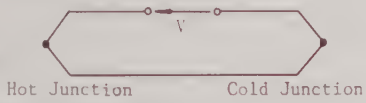
This section provides an overall functional description of this model and temperature probe.

Seebeck Effect

When two dissimilar metalic conductors are joined end to end and one of the ends is heated, produces a thermoelectric voltage in the circuit of which they form a part. Thomas Seebeck made this discovery in 1821.



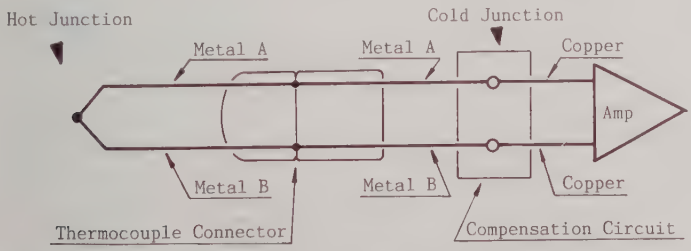
The most common combinations of two metalic conductors are listed in the following table.



TYPE K (CA)	Chromel-Almel
TYPE E (CRC)	Chromel-Constantan
TYPE J (IC)	Iron-Constantan
TYPE T (CC)	Copper-Constantan

Equivalent Circuit

An equivalent of the Seebeck Circuit is used on ANRITSU thermometers.



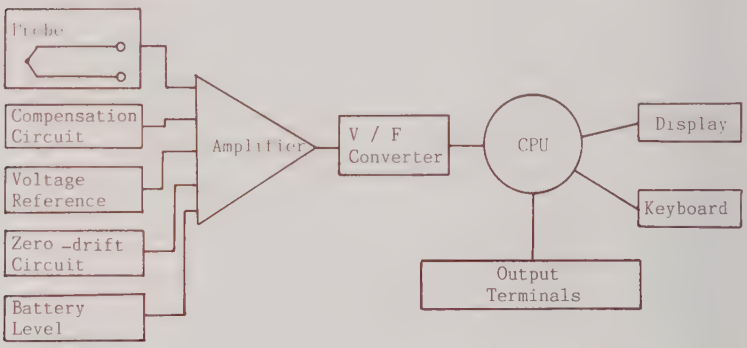
The combination of compensation voltage and the reference junction voltage is equal to the voltage of a 0°C cold junction.
And the voltage is referenced to 0°C, and be linearized and converted to temperature by using the NBS table.

Architecture

The major architecture of this model is shown in block diagram.

1) The 4-bit microprocessor senses the key operations.
2) The microprocessor controls the input terminals, output terminals, and the v/f converter.
3) The miroprocessor converts the voltage to temperature considering cold junction compensator, zero-drift, and fullscale-error.
4) The microprocessor displays and outputs the results.

Block Diagram



Auto-zero

If you have an old type weighing machine, you probably adjust the scale to zero before you weigh an object. The error called "zero-drift" which is also caused on electrical measuring instruments.

The microprocessor memorizes the value of zero-drift and then eliminates it automatically.

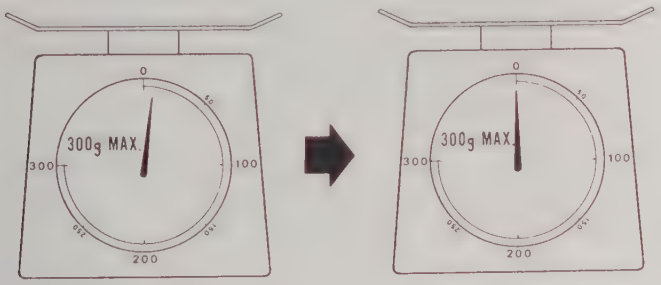
Auto-fullscale

Most weighing machines indicate a wrong weight when you use it many times or environment is changed.
The microprocessor senses the precise voltage reference and checks

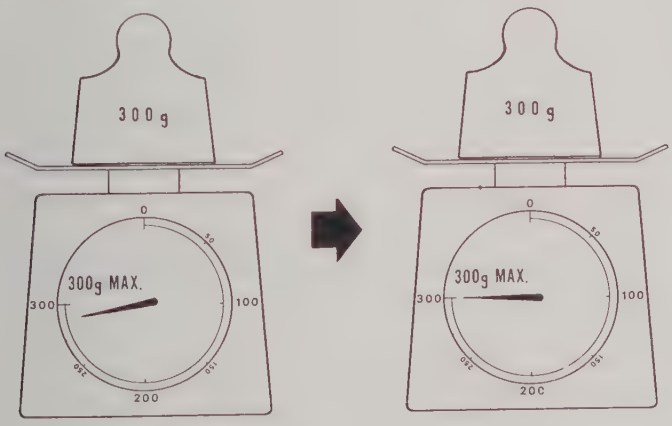
its fullscale.

The combination of the auto-zero and auto-fullscale introduces the most stable and accurate measurement.
We call this function Self-calibration.

■ Auto-zero



■ Auto-fullscale



Digital Linearization

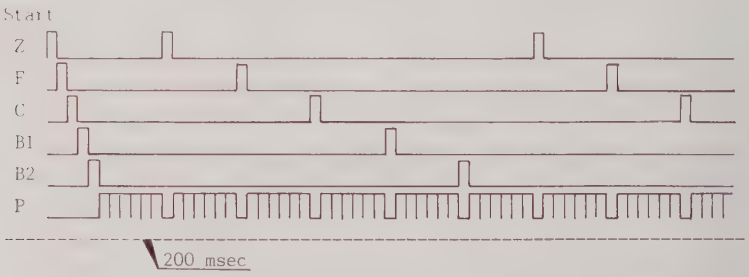
The temperature-versus-voltage relationship of the thermocouple is not linear. The thermocouple curve had been linearized by a combination of different gain amplifiers. This is called Analog (Hardware) linearization. They have been linearized by software routines stored in the microprocessor memory.
This is called Digital (Software) linearization.

The thermocouple characteristic curve is divided into 37 sectors and each sector is approximated by a linear curve.

Scan Timing

The microprocessor senses the all conditions (zero, fullscale, compensator, battery) before sensing by the probe when the power is turned on. After the first cycle each condition is sensed once for every six probe scans.

■ Timing Chart

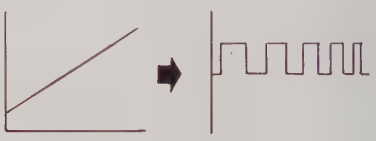


Z : Auto-zero, F : Auto-fullscale, C : Cold junction compensator
B1: Battery 1 B2: Battery 2 P : Probe

This scanning is started after the self-test mode.

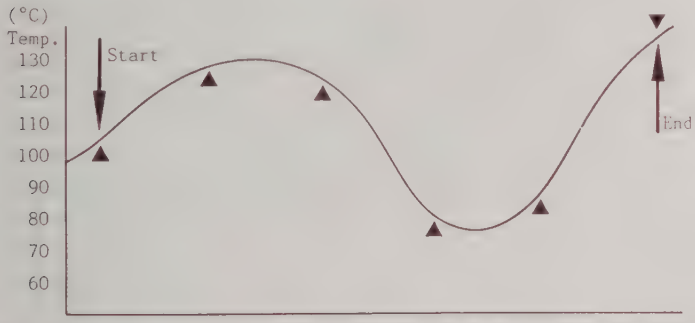
■ Voltage/Frequency Converter

The v/f converter converts the input voltage to the frequency.



Peak Valley Hold

The peak hold valley hold function is very useful for the precise measurement of unstable objects. This is because peak (maximum) temperature provides the best data during an unstable measurement when the object temperature is higher than room temperature, and valley (minimum) temperature is the best data when the object temperature is lower than room temperature.



Peak	104.8	128.3	130.2	130.2	130.2	137.6
Valley	104.8	104.8	104.8	81.0	76.9	76.9

Average

The temperature on the display in the AVE mode is averaged every 10 temperatures which are scaned every 200 msec.

This mode is usefull when the reading changes too fast to read.

Calibration

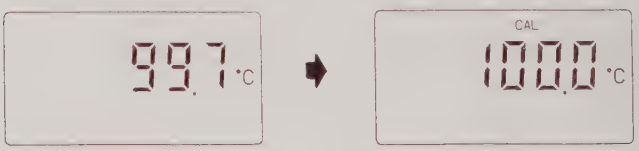
The purpose of CAL function is to calibrate the instrument and probe together. Most of accuracy of the temperature measurements depend on the probes.
This function presents you very precise temperature measurements.

This function gives a certain offset value to internal actual data. So the calibration should be done at the same temperature as you are going to measure.

[EXAMPLE]

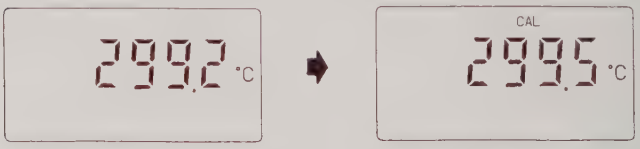
■ Calibration temperature : 100°C (Internal actual data was 99.7°C)

If you measure 100°C object.



Normal Mode CAL Mode

If you measure 300°C object after the previous calibration.



Normal Mode CAL Mode

[NOTE]

The instrument does not accept the CAL key operation if the overrange or burnout indicator is displayed.

MAINTENANCE

*** WARNING ***

THESE MAINTENANCE INSTRUCTIONS ARE INTENDED FOR USE BY QUALIFIED PERSONEEL ONLY. DO NOT PERFORM ANY OF THE TESTS IN THIS SECTION UNLESS YOU ARE QUALIFIED TO DO SO.

Introduction

This section provides maintenace information for this model and includes a performance test and a calibration test.

Test equipment recommended for the calibration test and performance test is listed below. If the recommended equipment is not available, equipment that neets the indicated minimum specifications may be substituted.

Recommended Equipment

DC Voltage Standard	YEW (YOKOGAWA HOKUSHIN ELECTRIC) Model 2553 DC VOLTAGE STANDARD 1 micro-volt resolution ±0.02% accuracy
Calibration Probe	ANRITSU Calibration Probe Model C513-H

Performance Test

This test compare the performance of this model with the specifications given in the Specifications SECTION 1. The test is recommended as an acceptance test when the instrument is first received.

To ensure optimum performance, the test must be performed at an ambient temperature between 20°C to 30°C (68°F to 86°F), with a relative humidity of less than 75%. The instrument should be allowed to warm up for 3 minutes prior to beginning any test.

■ Preparation for Test

The following conditions should be checked before the performance test.

1) Environmental conditions

Temperature ; 20°C to 30°C (68°F to 86°F)

Humidity ; Less than 75% R.H.

2) Absence of a noise source near the test area.

3) The battery level indicator of the instrument is not displayed.

■ Display Test

Turn on the power, then all the LCD segments in the display will turn on (Self Test mode) and the instrument will be in a measurement mode. For more details, refer to the Power On in the SECTION 2.

■ Key Board Test

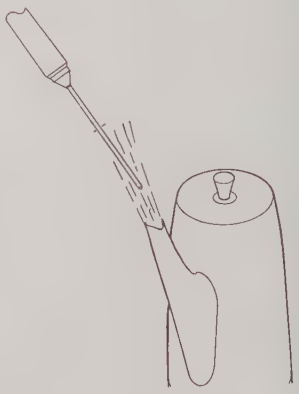
Refer to the each key function in SECTION 2.

■ Fixed Point Test

Testing the boiling point of water is very simple fixed point test with a reliable temperature source.

1) Connect the Calibration Probe to the input jack and measure the steam temperature.

2) The steam temperature is approx. 100°C, however the precise boiling temperature depends on atmospheric pressure during the test. Refer to the boiling temperature table on page 5-3 for the boiling point.



Use 100% pure water (distilled water) and refer to the table below to compare the results of the test. The Centigrade and Fahrenheit conversion formula is shown in below the table.

Boiling Point of Water

$$(°C) = 100.0 + 0.0367(P-760) - 0.000023(P-760)^2$$

P(mmHg) : Atmospheric pressure

Boiling Temperature Table

P	0	1	2	3	4	5	6	7	8	9
600	93.5	93.6	93.6	93.7	93.7	93.8	93.8	93.8	93.9	93.9
610	94.0	94.0	94.1	94.1	94.2	94.2	94.2	94.3	94.3	94.4
620	94.4	94.5	94.5	94.5	94.6	94.6	94.7	94.7	94.8	94.8
630	94.8	94.9	94.9	95.0	95.0	95.1	95.1	95.1	95.2	95.2
640	95.3	95.3	95.3	95.4	95.4	95.5	95.5	95.6	95.6	95.6
650	95.7	95.7	95.8	95.8	95.9	95.9	95.9	96.0	96.0	96.1
660	96.1	96.1	96.2	96.2	96.3	96.3	96.3	96.4	96.4	96.5
670	96.5	96.6	96.6	96.6	96.7	96.7	96.8	96.8	96.8	96.9
680	96.9	97.0	97.0	97.0	97.1	97.1	97.2	97.2	97.2	97.3
690	97.3	97.4	97.4	97.4	97.5	97.5	97.6	97.6	97.6	97.7
700	97.7	97.8	97.8	97.8	97.9	97.9	98.0	98.0	98.0	98.1
710	98.1	98.1	98.2	98.2	98.3	98.3	98.3	98.4	98.4	98.5
720	98.5	98.5	98.6	98.6	98.6	98.7	98.7	98.8	98.8	98.8
730	98.9	98.9	99.0	99.0	99.0	99.1	99.1	99.1	99.2	99.2
740	99.3	99.3	99.3	99.4	99.4	99.4	99.5	99.5	99.6	99.6
750	99.6	99.7	99.7	99.7	99.8	99.8	99.9	99.9	99.9	100.0
760	100.0	100.0	100.1	100.1	100.1	100.2	100.2	100.3	100.3	100.3
770	100.4	100.4	100.4	100.5	100.5	100.5	100.6	100.6	100.7	100.7
780	100.7	100.8	100.8	100.8	100.9	100.9	100.9	101.0	101.0	101.0
790	101.1	101.1	101.2	101.2	101.2	101.3	101.3	101.3	101.4	101.4
800	101.4	101.5	101.5	101.5	101.6	101.6	101.6	101.7	101.7	101.7

Unit : °C

°C and °F Conversion Formula

$$[°F] = 1.8 \times [°C] + 32$$

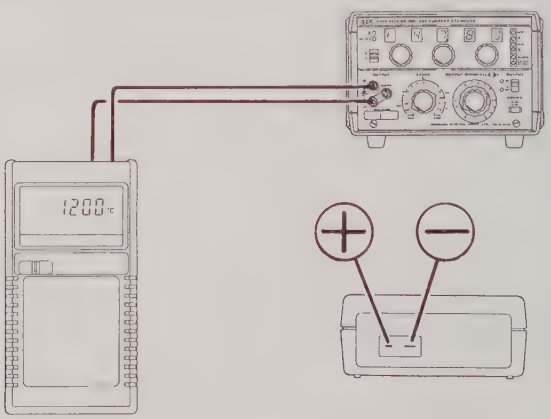
Calibration Test

Connect the dc voltage standard to provide a voltage input to the probe jack instead of thermocouple voltage.

At the first step, connect a short across the input jack and read the display which is cold junction temperature.
Usually this cold junction temperature is almost the same as ambient (room) temperature.

For each step in Reference Table (see page 5-5) set the dc voltage standard for the specified input voltage and verify that the error of display reading is within the accuracy written in the specifications.

■ Connections for dc voltage standard



[CAUTION]

Do not turn on both instruments while connecting the voltage standard to the digital thermometer.

Voltage input should not exceed 100mV.

Reference Tables

Please note that the thermocouple voltage table in this section supersede N.B.S. circular #561.

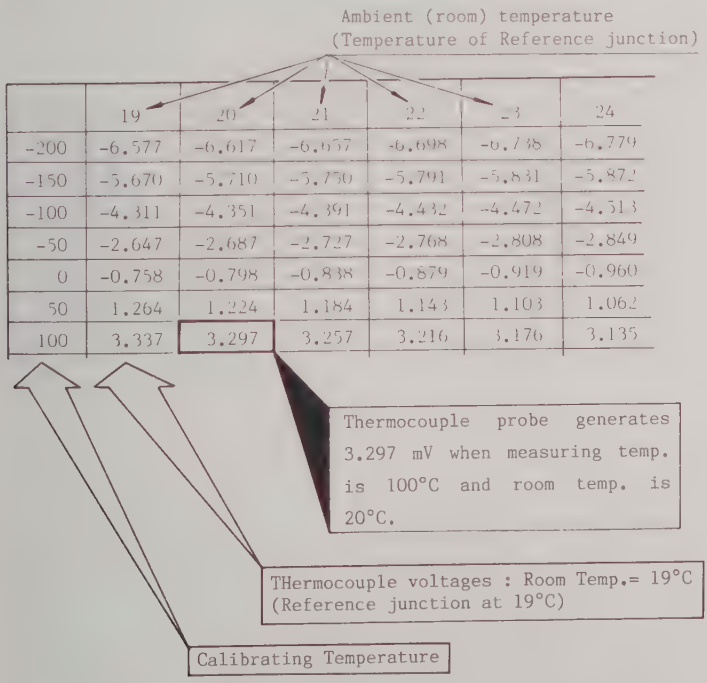
■ Thermocouple types

Type K = Nickel-Chromium Vs. Nickel-Aluminum

Type E = Nickel-Chromium Vs. Copper-Nickel

Type J = Iron Vs. Copper-Nickel

■ How to read the reference tables.


Ambient (room) temperature
(Temperature of Reference junction)
Thermocouple probe generates 3.297 mV when measuring temp. is 100°C and room temp. is 20°C.
THermocouple voltages : Room Temp.= 19°C (Reference junction at 19°C)
Calibrating Temperature

	19	20	21	22	23	24
-200	-6.577	-6.617	-6.657	-6.698	-6.738	-6.779
-150	-5.670	-5.710	-5.750	-5.791	-5.831	-5.872
-100	-4.311	-4.351	-4.391	-4.432	-4.472	-4.513
-50	-2.647	-2.687	-2.727	-2.768	-2.808	-2.849
0	-0.758	-0.798	-0.838	-0.879	-0.919	-0.960
50	1.264	1.224	1.184	1.143	1.103	1.062
100	3.337	3.297	3.257	3.216	3.176	3.135

Nickel-Chromium Vs. Nickel-Aluminum

K

	19	20	21	22	23	24	25	26	27	28	29	30
-200	-6.[illegible]	[illegible]	[illegible]	-6.698	-6.738	-6.779	-6.819	-6.860	-6.900	-6.941	-6.981	-7.022
-150	-5.[illegible]	-5.[illegible]	-5.751	-5.791	-5.831	-5.872	-5.912	-5.953	-5.993	-6.034	-6.074	-6.115
-100	-4.[illegible]	-4.[illegible]	-4.391	-4.432	-4.472	-4.513	-4.553	-4.594	-4.634	-4.675	-4.715	-4.756
-50	-2.[illegible]	-2.[illegible]	-2.787	-2.828	-2.868	-2.909	-2.949	-2.990	-3.030	-3.071	-3.111	-3.152
0	-0.[illegible]	-0.[illegible]	-0.878	-0.919	-0.960	-1.000	-1.041	-1.081	-1.122	-1.162	-1.203	
50	1.284	1.244	1.204	1.163	1.123	1.082	1.042	1.002	0.961	0.921	0.880	0.840
100	3.337	3.297	3.256	3.216	3.176	3.135	3.095	3.054	3.014	2.973	2.933	2.892
150	5.429	5.388	5.348	5.308	5.268	5.227	5.187	5.147	5.106	5.066	5.025	4.985
200	7.559	7.519	7.479	7.438	7.398	7.358	7.318	7.277	7.237	7.196	7.156	7.115
250	9.729	9.689	9.648	9.608	9.567	9.527	9.486	9.446	9.405	9.365	9.324	9.284
300	11.939	11.898	11.858	11.817	11.777	11.736	11.696	11.655	11.615	11.574	11.534	11.493
350	14.187	14.146	14.106	14.065	14.025	13.984	13.944	13.903	13.863	13.822	13.782	13.741
400	16.472	16.431	16.391	16.350	16.309	16.269	16.228	16.187	16.147	16.106	16.065	16.025
450	18.792	18.751	18.710	18.669	18.628	18.587	18.546	18.505	18.464	18.423	18.382	18.341
500	21.146	21.105	21.064	21.023	20.982	20.941	20.900	20.859	20.818	20.777	20.736	20.695
550	23.533	23.492	23.451	23.410	23.369	23.328	23.287	23.246	23.205	23.164	23.123	23.082
600	25.952	25.911	25.870	25.829	25.788	25.747	25.706	25.665	25.624	25.583	25.542	25.501
650	28.402	28.361	28.320	28.279	28.238	28.197	28.156	28.115	28.074	28.033	27.992	27.951
700	30.881	30.840	30.799	30.758	30.717	30.676	30.635	30.594	30.553	30.512	30.471	30.430
750	33.389	33.348	33.307	33.266	33.225	33.184	33.143	33.102	33.061	33.020	32.979	32.938
800	35.924	35.883	35.842	35.801	35.760	35.719	35.678	35.637	35.596	35.555	35.514	35.473
850	38.485	38.444	38.403	38.362	38.321	38.280	38.239	38.198	38.157	38.116	38.075	38.034
900	41.073	41.032	40.991	40.950	40.909	40.868	40.827	40.786	40.745	40.704	40.663	40.622
950	43.686	43.645	43.604	43.563	43.522	43.481	43.440	43.399	43.358	43.317	43.276	43.235
1000	46.321	46.280	46.239	46.198	46.157	46.116	46.075	46.034	45.993	45.952	45.911	45.870
1050	48.976	48.935	48.894	48.853	48.812	48.771	48.730	48.689	48.648	48.607	48.566	48.525
1100	51.650	51.609	51.568	51.527	51.486	51.445	51.404	51.363	51.322	51.281	51.240	51.199
1150	54.341	54.300	54.259	54.218	54.177	54.136	54.095	54.054	54.013	53.972	53.931	53.890
1200	57.047	57.006	56.965	56.924	56.883	56.842	56.801	56.760	56.719	56.678	56.637	56.596
1250	59.765	59.724	59.683	59.642	59.601	59.560	59.519	59.478	59.437	59.396	59.355	59.314
1300	62.494	62.453	62.412	62.371	62.330	62.289	62.248	62.207	62.166	62.125	62.084	62.043
1350	65.232	65.191	65.150	65.109	65.068	65.027	64.986	64.945	64.904	64.863	64.822	64.781
1400	67.977	67.936	67.895	67.854	67.813	67.772	67.731	67.690	67.649	67.608	67.567	67.526
1450	70.727	70.686	70.645	70.604	70.563	70.522	70.481	70.440	70.399	70.358	70.317	70.276
1500	73.480	73.439	73.398	73.357	73.316	73.275	73.234	73.193	73.152	73.111	73.070	73.029
1550	76.234	76.193	76.152	76.111	76.070	76.029	75.988	75.947	75.906	75.865	75.824	75.783
1600	78.987	78.946	78.905	78.864	78.823	78.782	78.741	78.700	78.659	78.618	78.577	78.536
1650	81.737	81.696	81.655	81.614	81.573	81.532	81.491	81.450	81.409	81.368	81.327	81.286
1700	84.482	84.441	84.400	84.359	84.318	84.277	84.236	84.195	84.154	84.113	84.072	84.031
1750	87.220	87.179	87.138	87.097	87.056	87.015	86.974	86.933	86.892	86.851	86.810	86.769
1800	89.949	89.908	89.867	89.826	89.785	89.744	89.703	89.662	89.621	89.580	89.539	89.498
1850	92.667	92.626	92.585	92.544	92.503	92.462	92.421	92.380	92.339	92.298	92.257	92.216
1900	95.372	95.331	95.290	95.249	95.208	95.167	95.126	95.085	95.044	95.003	94.962	94.921
1950	98.062	98.021	97.980	97.939	97.898	97.857	97.816	97.775	97.734	97.693	97.652	97.611
2000	100.737	100.696	100.655	100.614	100.573	100.532	100.491	100.450	100.409	100.368	100.327	100.286
2050	103.397	103.356	103.315	103.274	103.233	103.192	103.151	103.110	103.069	103.028	102.987	102.946
2100	106.041	106.000	105.959	105.918	105.877	105.836	105.795	105.754	105.713	105.672	105.631	105.590
2150	108.668	108.627	108.586	108.545	108.504	108.463	108.422	108.381	108.340	108.299	108.258	108.217
2200	111.277	111.236	111.195	111.154	111.113	111.072	111.031	110.990	110.949	110.908	110.867	110.826
2250	113.867	113.826	113.785	113.744	113.703	113.662	113.621	113.580	113.539	113.498	113.457	113.416
2300	116.436	116.395	116.354	116.313	116.272	116.231	116.190	116.149	116.108	116.067	116.026	115.985
2350	118.984	118.943	118.902	118.861	118.820	118.779	118.738	118.697	118.656	118.615	118.574	118.533
2400	121.509	121.468	121.427	121.386	121.345	121.304	121.263	121.222	121.181	121.140	121.099	121.058
2450	124.011	123.970	123.929	123.888	123.847	123.806	123.765	123.724	123.683	123.642	123.601	123.560
2500	126.488	126.447	126.406	126.365	126.324	126.283	126.242	126.201	126.160	126.119	126.078	126.037

Nickel-Chromium Vs. Copper-Nickel

E

	19	20	21	22	23	24	25	26	27	28	29	30
-200	-9.955	-10.016	-10.076	-10.137	-10.197	-10.258	-10.319	-10.380	-10.441	-10.502	-10.563	-10.625
-150	-8.410	-8.471	-8.531	-8.592	-8.652	-8.713	-8.774	-8.835	-8.896	-8.957	-9.018	-9.080
-100	-6.368	-6.429	-6.489	-6.550	-6.610	-6.671	-6.732	-6.793	-6.854	-6.915	-6.976	-7.038
-50	-3.918	-3.979	-4.039	-4.100	-4.160	-4.221	-4.282	-4.343	-4.404	-4.465	-4.526	-4.588
0	-1.131	-1.192	-1.252	-1.313	-1.373	-1.434	-1.495	-1.556	-1.617	-1.678	-1.739	-1.801
50	1.916	1.855	1.795	1.734	1.674	1.613	1.552	1.491	1.430	1.369	1.308	1.246
100	5.186	5.125	5.065	5.004	4.944	4.883	4.822	4.761	4.700	4.639	4.578	4.516
150	8.656	8.595	8.535	8.474	8.414	8.353	8.292	8.231	8.170	8.109	8.048	7.986
200	12.288	12.227	12.167	12.106	12.046	11.985	11.924	11.863	11.802	11.741	11.680	11.618
300	19.902	19.841	19.781	19.720	19.660	19.599	19.538	19.477	19.416	19.355	19.294	19.232
400	27.812	27.751	27.691	27.630	27.570	27.509	27.448	27.387	27.326	27.265	27.204	27.142
500	35.868	35.807	35.747	35.686	35.626	35.565	35.504	35.443	35.382	35.321	35.260	35.198
600	43.954	43.893	43.833	43.772	43.712	43.651	43.590	43.529	43.468	43.407	43.346	43.284
700	51.969	51.908	51.848	51.787	51.727	51.666	51.605	51.544	51.483	51.422	51.361	51.299
800	59.891	59.830	59.770	59.709	59.649	59.588	59.527	59.466	59.405	59.344	59.283	59.221

Iron Vs. Copper Nickel

J

	19	20	21	22	23	24	25	26	27	28	29	30
-200	-8.857	-8.909	-8.960	-9.012	-9.064	-9.115	-9.167	-9.219	-9.271	-9.322	-9.374	-9.426
-150	-7.466	-7.518	-7.569	-7.621	-7.673	-7.724	-7.776	-7.828	-7.880	-7.931	-7.983	-8.035
-100	-5.599	-5.651	-5.702	-5.754	-5.806	-5.857	-5.909	-5.961	-6.013	-6.064	-6.116	-6.168
-50	-3.398	-3.450	-3.501	-3.553	-3.605	-3.656	-3.708	-3.760	-3.812	-3.863	-3.915	-3.967
0	-0.967	-1.019	-1.070	-1.122	-1.174	-1.225	-1.277	-1.329	-1.381	-1.432	-1.484	-1.536
50	1.618	1.566	1.515	1.463	1.411	1.360	1.308	1.256	1.204	1.153	1.101	1.049
100	4.301	4.249	4.198	4.146	4.094	4.043	3.991	3.939	3.887	3.836	3.784	3.732
150	7.041	6.989	6.938	6.886	6.834	6.783	6.731	6.679	6.627	6.576	6.524	6.472
200	9.810	9.758	9.707	9.655	9.603	9.552	9.500	9.448	9.396	9.345	9.293	9.241
300	15.358	15.306	15.255	15.203	15.151	15.100	15.048	14.996	14.944	14.893	14.841	14.789
400	20.879	20.827	20.776	20.724	20.672	20.621	20.569	20.517	20.465	20.414	20.362	20.310
500	26.421	26.369	26.318	26.266	26.214	26.163	26.111	26.059	26.007	25.956	25.904	25.852
600	32.129	32.077	32.026	31.974	31.922	31.871	31.819	31.767	31.715	31.664	31.612	31.560
700	38.163	38.111	38.060	38.008	37.956	37.905	37.853	37.801	37.749	37.698	37.646	37.594

LIST OF REPLACEABLE PARTS

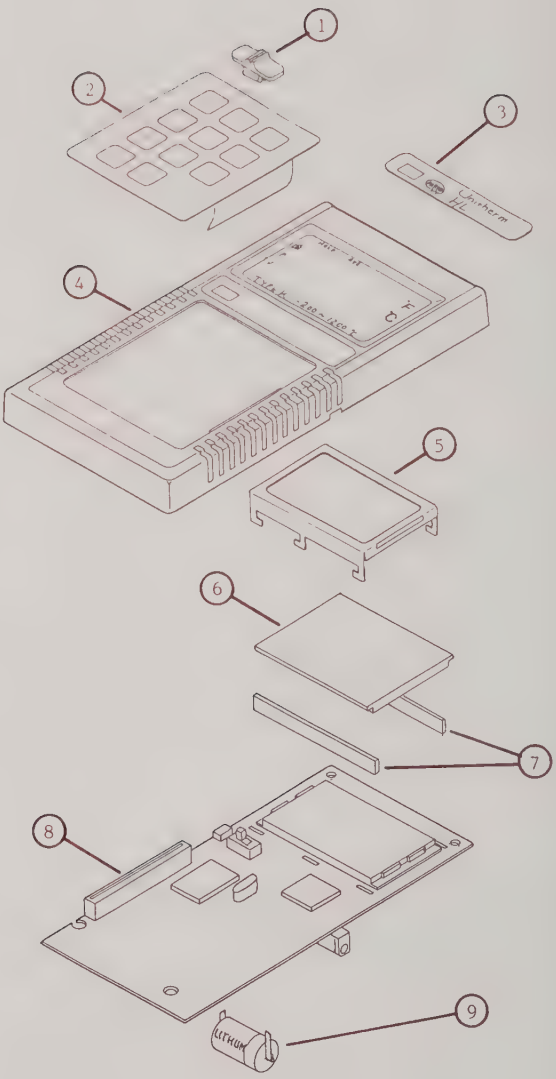
How to obtain parts

To ensure prompt and efficient handling of your order, please include the following information.

1. Parts No.
2. Description
3. Quantity
4. Instrument model and serial number

Replaceable parts of HL610

REF	DESCRIPTION	PARTS NO.	QTY
1	Power switch	PR001-HL610	1
2	Key board	PR002-HL610	1
3	Model name label	PR003-HL610	1
4	Case (front)	PR004-HL610	1
5	LCD holder	PR005-HL610	1
6	LCD display plate	PR006-HL610	1
7	LCD drive conductor	PR007-HL610	2
8	P.C. board (main board)	PR008-HL610	1
9	Lithum battery	PR009-HL610	1
10	Input jack holder	PR010-HL610	1
11	Input jack with cold junction	PR011-HL610	1
12	CAL interfce connector	PR027-HL610	1
13	P.C. board (interface controller)	PR028-HL610	1
14	Battery power cable	PR016-HL610	1
15	Case (back)	PR029-HL610	1
16	Hand strap	PR017-HL610	1
17	Battery compartment cover	PR019-HL610	1
18	Instruction label	PR020-HL610	1
19	Battery holding spring	PR022-HL610	5
20	Dry battery	PR021-HL610	4
21	Screw	PR023-HL610	4
22	Rugged protective case	PR024-HL610	1
23	Packing case	PR025-HL610	1
24	Instruction manual	PR026-HL610	1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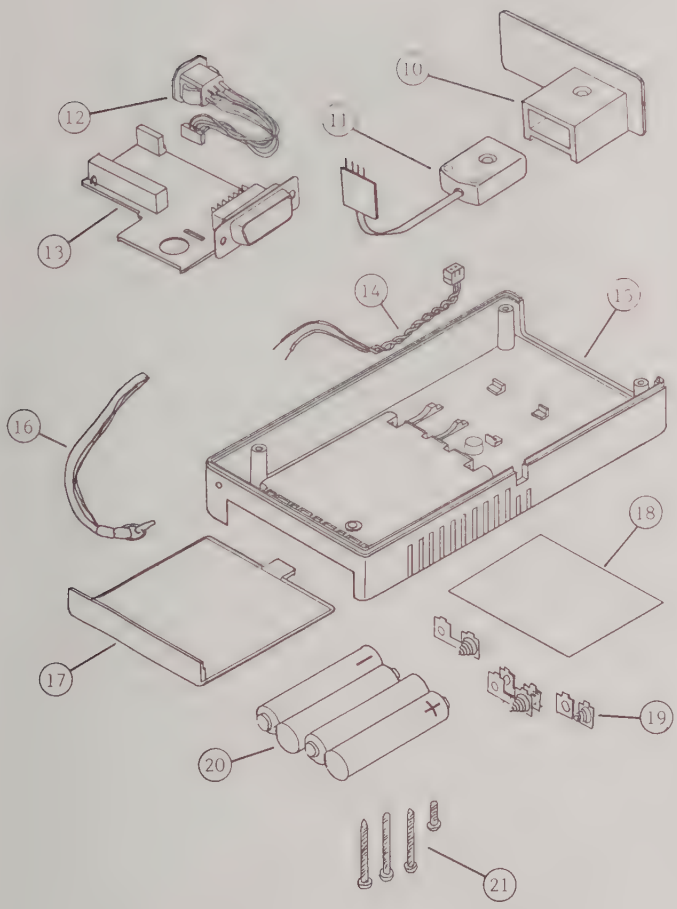
LITHIUM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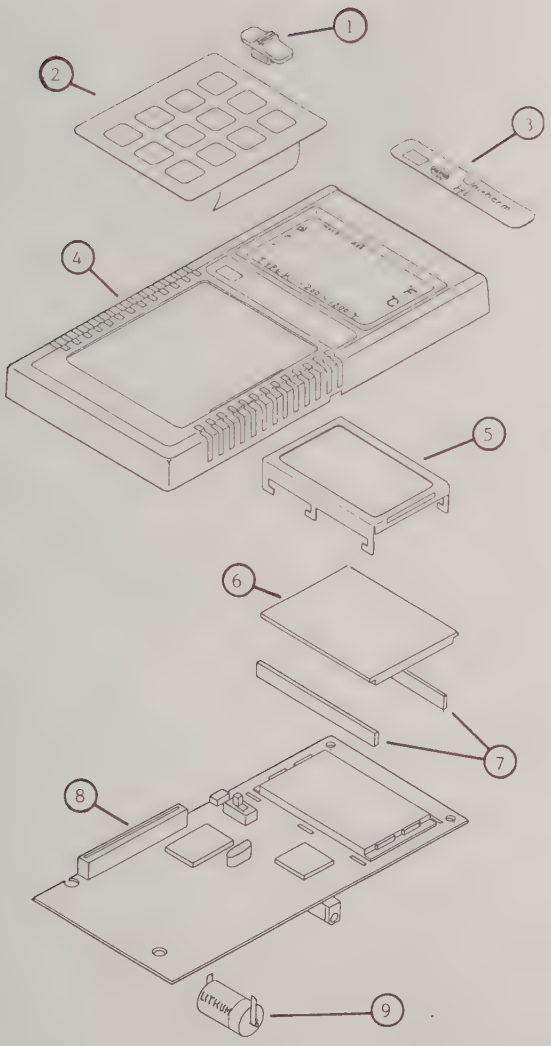
Replaceable parts of HL620

[illegible]	DESCRIPTION	PARTS NO.	QTY
1	Power switch	PR001-HL620	1
2	Key board	PR002-HL620	1
[illegible]	Model name label	PR003-HL620	1
4	Case (front)	PR004-HL620	1
5	LCD holder	PR005-HL620	1
6	LCD display plate	PR006-HL620	1
7	LCD drive conductor	PR007-HL620	2
8	P.C. board (main board)	PR008-HL620	1
9	Lithum battery	PR009-HL620	1
10	Input jack holder	PR010-HL620	1
11	Input jack with cold junction	PR011-HL620	1
12	CAL interfce connector	PR027-HL620	1
13	P.C. board (interface controller)	PR028-HL620	1
14	Battery power cable	PR016-HL620	1
15	Case (back)	PR029-HL620	1
16	Hand strap	PR017-HL620	1
17	Battery compartment cover	PR019-HL620	1
18	Instruction label	PR020-HL620	1
19	Battery holding spring	PR022-HL620	5
20	Dry battery	PR021-HL620	4
21	Screw	PR023-HL620	4
22	Rugged protective case	PR024-HL620	1
23	Packing case	PR025-HL620	1
24	Instruction manual	PR026-HL620	1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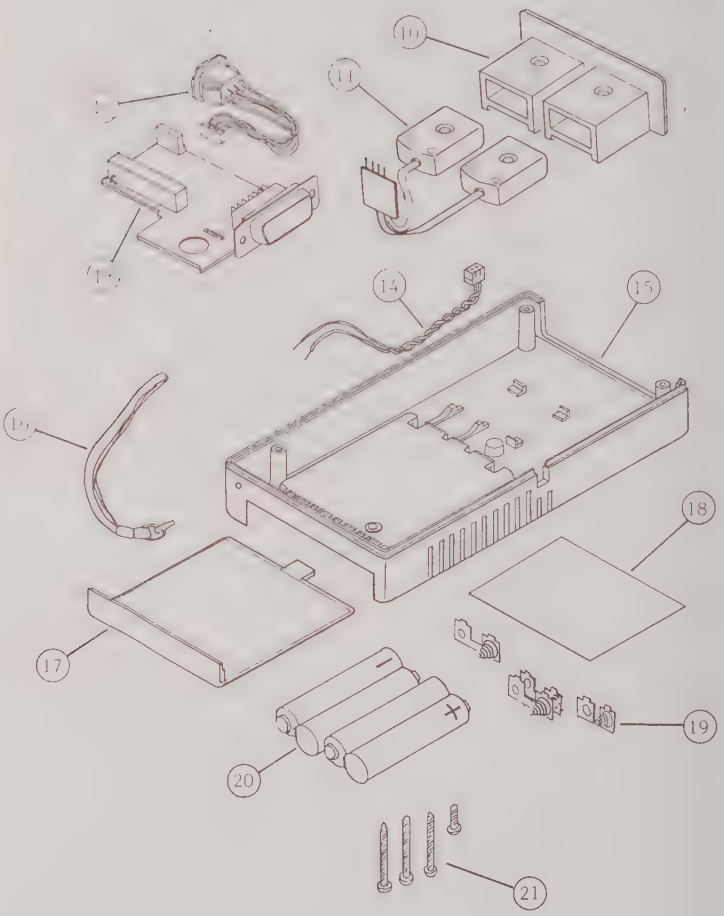
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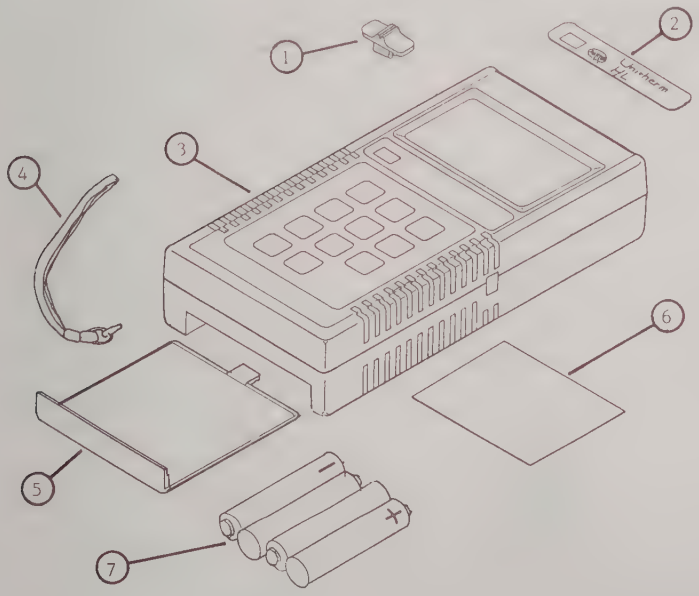
Replaceable parts of HL610 LIMITED

All the replacements of electronics parts (open case replacements) should be operated in the ANRITSU METER CO., LTD. TOKYO JAPAN. Otherwise the accuracy of this model can not be guarranteed.

REF	DESCRIPTION	PARTS NO.	QTY
1	Power switch	PR001-HL610	1
2	Model name label	PR003-HL610	1
3	HL610 LIMITED body	PR001-HL610L	1
4	Hand strap	PR017-HL610	1
5	Battery compartment cover	PR019-HL610	1
6	Instruction label	PR020-HL610	1
7	Dry battery	PR021-HL610	4
8	Rugged protective case	PR024-HL610	1
9	Packing case	PR025-HL610	1
10	Instruction manual	PR026-HL610	1



** NOTES **

INTERCHANGEABLE THERMOCOUPLE PROBES

Standard Surface Probes

Model 101 (C101)
For stationary surfaces.
500 °C max. t(99)=2 sec

Model 111 (C111)
For stationary surfaces
500 °C max. t(99)=2 sec

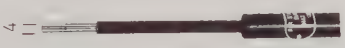
Model 112 (C112)
For stationary surfaces
500 °C max. t(99)=2 sec

Model 113 (C113)
For stationary frangible surfaces
400 °C max. Glass Teflon guarded.
t(99)=2 sec

Model 330 (C330)
For stationary surfaces
800 °C max. t(99)=2 sec

Small Surface Probes

Model 353 (C353)
For stationary small surface areas
400 °C max. t(99)=1 sec



Model 124 (C124)
For stationary surfaces
250 °C max. Magnetic supporting.
t(99)=1 sec

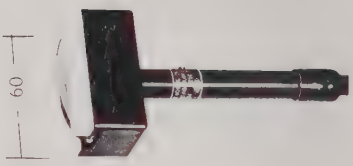
Model 126 (C126)
For stationary surfaces
300 °C max. t(99)=0.6 sec
Most precise and quick response.

Moving Surface Probes

Model 201 (C201)

For moving surfaces

250 °C max. Teflon guarded.
t(99)=3 sec



Model 211 (C211)

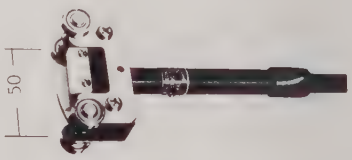
Heavy duty moving surfaces probe

200 °C max. t(99)=5 sec

Model 423 (C423)

Roll bearings model

200 °C max. t(99)=2 sec



Penetration Probe

Model 526 (C526)

Mini Hypodermic probe

200 °C max. t(99)=1 sec

Model 513 (C513)

General purpose penetration probe

500 °C max. t(99)=2 sec

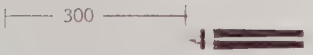
Model 701 (C701)

Heavy duty penetration probe

300 °C max. t(99)=3 sec

Air (Gas) Probe

Model 510 (C510)
General purpose air probe
500 °C max. t(99)=4 sec



Flat Leaf Probe

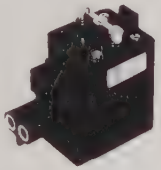
Model 529 (C529)
Thin flat leaf probe
200 °C max. t(99)=1 sec

Oil Tank Probe

Model 530 (C530)
50m of strong extension cable is available.
250°C max. t(99)=4 sec

Soldering Iron Probe

Model 754 (C754)
Soldering iron probe
500 °C max. t(99)=4 sec



Heavy Duty Surface Probe

Model 619 (C619)
Heavy duty surface probe
700 to 1200 °C t(99)=10 sec

For more types of probe, see our catalog.

** NOTES **

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** NOTES **

** NOTES **

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